

100BASE-Cu

Multi-Mode

Proposed Copper EFM PHY



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NETWORKS**

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- ✓ **The P2P Copper Portion of the 802.3ah Standard must provide Ethernet over Voice Grade Copper [1] as presented by Hugh Barrass of Cisco at the July EFM meeting**
- ✓ **Extensive dialogue on the EFM Reflector indicates Service Providers desire:**
 - ◆ Reach to 10kft or greater
 - ◆ Rates of 10 Mbps or greater
 - ◆ Spectral compatibility
 - ◆ Ease of deployment
 - ◆ Bandwidth symmetry
 - ◆ In-home compatibility
 - ◆ Self-Installs, no special demarc

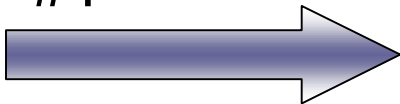
- ✓ **Two Base Technologies have been proposed:**
 - ◆ Both utilize FULL DUPLEX MII interfaces to the user

- ✓ **VDSL as presented by: 3Com, Alcatel, Broadcom, Globespan, Ikanos, Infineon, ST in current proposals [2],...,[8] including QAM and DMT implementations**
 - ◆ FDD based (Bounded, yet highly predictable)
 - ◆ Fixed Symmetry
 - ◆ Reach < 5,000 Ft (+/-)

- ✓ **100BaseCu**
 - ◆ Burst Mode (Statistical, Optimizes for loop conditions)
 - ◆ Flexible Symmetry
 - ◆ Reach to 21,000 Feet

“The Bad” - *Revisited*

#1



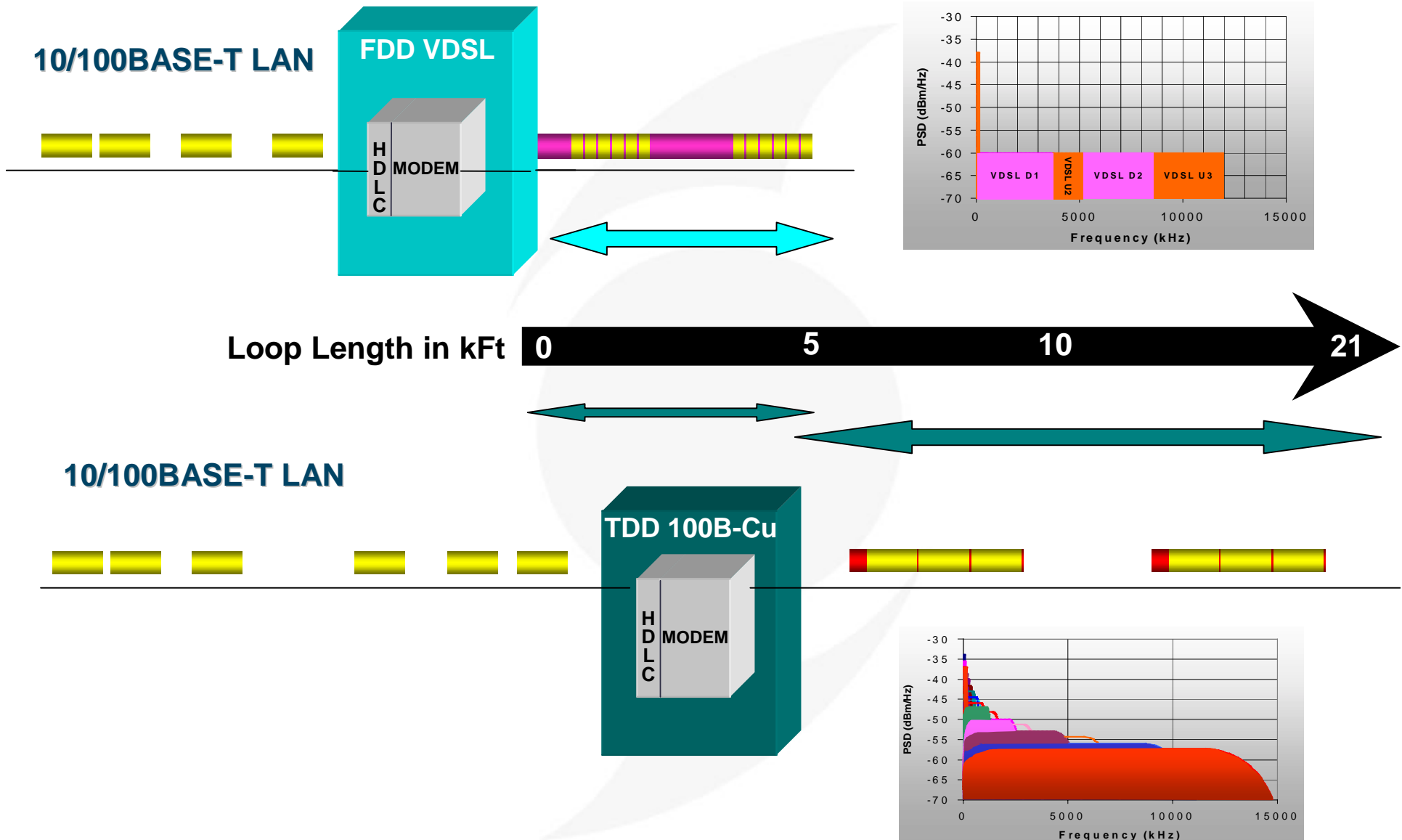
- **FDD vs TDD**
... don't forget spectral management
- **DMT vs QAM**
The bug-bear of standards efforts
- **MII → FEC framing**
Raw or encapsulate
- **More to come...**
Note too much, I hope!

- ✓ Why not implement a *Multi-Mode* solution which utilizes both duplexing techniques where they perform best?

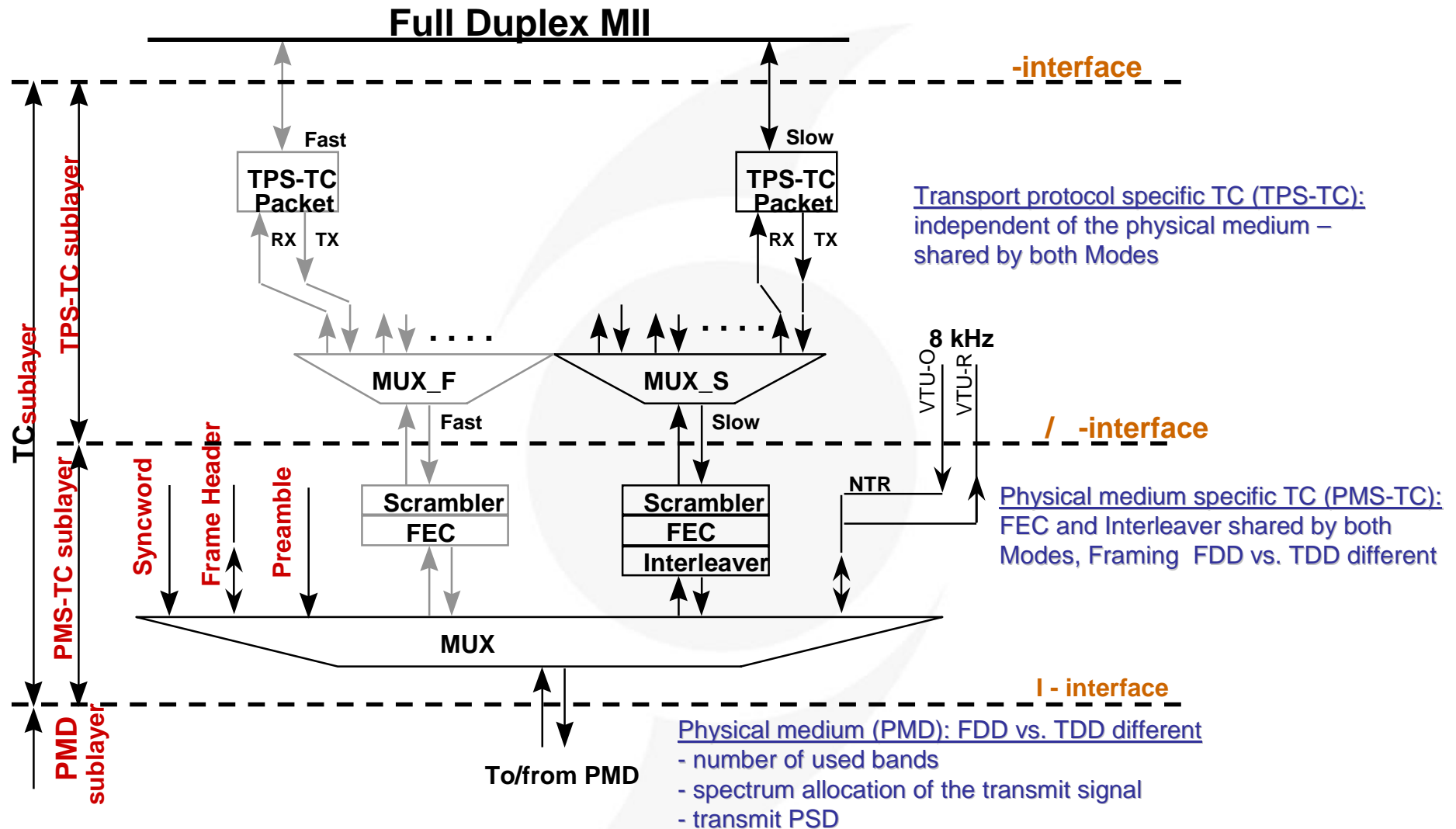
100BaseCu *Multi-Mode* Combines VDSL and 100BaseCu

- ✓ One silicon solution capable of both modes
- ✓ Auto sense or provisionable
- ✓ Spectrally compatible
- ✓ Can be implemented over QAM or DMT VDSL solutions
- ✓ 100BaseCu *Multi-Mode* allows the Application or the Service Provider to decide which attributes are most important
 - ◆ FDD, Short reach, fixed symmetry, FEXT limited, constant latency
 - ◆ Burst, long reach, flexible symmetry ratios, more graceful line sharing with HPNA, automatic spectral compatibility, line monitoring

100BaseCu Multi-Mode Component Technologies



100BASE-Cu Multi-Mode PHY



✓ **Technical Feasibility**

- ◆ Both technologies have been demonstrated, and use similar bandwidths and modulation densities

✓ **Broad Market Potential**

- ◆ The combined technology can reach a greater number of subscribers and service a broader range of applications

✓ **Distinct Identity**

- ◆ Consistent with stated 802.3ah PAR

✓ **Proposed Operational Modes (others may be suggested)**

- ◆ Auto-Sense
 - ◆ Operates in Dynamic TDD mode, with Spectrum Manager listening for coupling with 988 plan
 - ◆ When coupled with 998 plan, switches to EoVDSL-like FDD, with Spectrum Manager listening for opportunity to switch back to dynamic TDD
 - ◆ Additional provisionable option can limit Upstream frequency range to favor asymmetric service, heavier on downstream
- ◆ Provisionable – Service Provider can provision to EoVDSL like FDD mode or TDD only mode

✓ **Economic Feasibility**

- ◆ Common bandwidth utilizes the same AFE
- ◆ Gate count increased, but likely offset by exponentially greater addressable market and corresponding silicon volume
- ◆ Gate count increase potentially offset by using 2 band VDSL

Meets the Broadest Needs of the Marketplace

- ✓ **Much larger addressable market due to greater rate vs. reach [9]**
- ✓ **One technology that covers both in-building and outside plant**
- ✓ **Spectrum Manager Function gives visibility of binder conditions [10] for continuous optimization in burst mode**
- ✓ **EoVDSL like mode gives fixed, but determinate, service on short loops**
- ✓ **Wide range of technology vendors to provide phys**
- ✓ **Robust: Leverages Current Loop-Tolerant Implementations**

References



- [1] **“Voice Grade Copper,” Cisco, IEEE 802.3 EFM Study Group, Interim Meeting July, 2001**
- [2] **“A Case for the Marriage of Ethernet and DSL,” 3com, IEEE 802.3 EFM Study Group, Interim Meeting, January 2001**
- [3] **“VDSL and packet Transport,” Alcatel, IEEE 802.3 EFM Study Group Plenary, March 2001**
- [4] **“EFM Copper,” IEEE 802.3 EFM Study Group, Interim Meeting, May 2001**
- [5] **“Standard VDSL Technology,” Broadcom, IEEE 802.3 EFM Study Group Plenary, July 2001**
- [6] **“EFM Data Rate Analysis,” Ikanos, IEEE 802.3 EFM Study Group Plenary, July 2001**
- [7] **“EoVDSL,” Infineon Technologies, IEEE 802.3 EFM Study Group Plenary, July 2001**
- [8] **“Standard DMT VDSL for EFM,” ST Microelectronics, IEEE 802.3 EFM Study Group Plenary, July 2001**
- [9] **“Carrier Grade Ethernet ,” Elastic Networks, IEEE 802.3 EFM Study Group, Interim Meeting, May 2001**
- [10] **“Fast Robust EFM,” Elastic Networks, IEEE 802.3 EFM Study Group, Plenary, March 2001**